## $^{9}$Be($^{46}$Ar,$^{44}$S$\gamma$) 2011Sa25,2017Pa02,2006Fr13

History

| Type | Author | Citation | Literature Cutoff Date |
|---|---|---|---|
| Full Evaluation | Jun Chen and Balraj Singh | NDS 190,1 (2023) | 20-Jun-2023 |

2011Sa25: E=99.9 MeV/nucleon $^{46}$Ar beam produced from fragmentation of $^{48}$Ca beam at 140 MeV/nucleon with a 705 mg/cm$^2$ thick $^{9}$Be target, rate of $^{46}$Ar $7\times10^5$ pps. Secondary target of a 188 mg/cm$^2$ thick $^{9}$Be. Fragments were separated by A1900 separator at the National Superconducting Cyclotron Laboratory (NSCL) at Michigan State University. $\gamma$-rays were detected by the SeGA array of 17 segmented Ge detectors and residues were analyzed in the S800 spectrograph. Measured E$\gamma$, $\gamma\gamma$-coin, $\sigma$(E$\gamma$). Deduced levels. Comparison with shell-model calculations.

2017Pa02: E=99 MeV/nucleon $^{46}$Ar beam produced from fragmentation of $^{48}$Ca beam at 140 MeV/nucleon on a $^{9}$Be target, and ions were separated by A1900 separator at NSCL-MSU facility. The $^{9}$Be target was placed at an adjustable distance from a 1 mm thick Nb degrader. $\gamma$-rays were detected by the GRETINA array, and $^{44}$S particles were analyzed in the S800 spectrograph. Measured E$\gamma$, ($^{44}$S)$\gamma$-coin and $\gamma\gamma$-coin, level lifetimes by recoil-distance Doppler shift method (RDM) using a plunger device. Comparison with theoretical predictions.

2006Fr13, 2005Fr19: E=98.1 MeV/nucleon $^{46}$Ar beam produced from fragmentation of $^{48}$Ca beam at 140 MeV/nucleon with a $^{9}$Be target. Fragments were separated by A1900 separator at NSCL, Michigan facility. The $^{46}$Ar beam impinged another $^{9}$Be target and the residues were analyzed by S800 spectrograph. The knockout residues were identified by time-of-flight, energy loss measurement, position and angle information; $\gamma$ rays were detected in coincidence with knockout residues of $^{44}$S using SeGA array of highly-segmented HPGe detectors.

Total cross section for $^{44}$S=0.23 mb *2* in comparison with 0.66 mb from theoretical predictions, or 0.33 mb if suppression factor of ≈0.5 is used for two-nucleon shell-model strength (2006Fr13, 2005Fr19).

### $^{44}$S Levels

| E(level)† | J$^\pi$‡ | T$_{1/2}$ | $\sigma$ (mb)# | Comments |
|---|---|---|---|---|
| 0 | 0$^+$ | | | |
| 1319 *7* | 2$^+$ | | 0.014 *3* | |
| 1357 *14* | 0$^+$ | | | E(level): level defined in 2011Sa25 through the tentative placement of 1891-keV $\gamma$ ray. Existence of this level is based on finding of a 2.6−$\mu$s isomer at 1365 keV (2010Fo04). |
| 2150 *11* | (2$^+$) | | 0.004 *1* | |
| 2268 *9* | 2$^+$ | <2.1 ps | 0.022 *4* | T$_{1/2}$: recoil-distance method (2017Pa02), only an upper limit estimated from observation of only one peak for 949$\gamma$, indicative of a prompt transition, in contrast to the 1140 and 1319 $\gamma$ rays, both of which show two distinct peaks. |
| 2447 *9* | 4$^+$ | 53 ps *17* | 0.019 *4* | T$_{1/2}$: measured mean lifetime $\tau$=76 ps *14*(stat) *20*(syst) using recoil-distance method (2017Pa02). The two uncertainties have been added in quadrature by evaluators. Based on experimental B(E2)(W.u.) value, the 4$^+$ level is interpreted by 2017Pa02 as an isomer with $K^\pi$=4$^+$, and not as a member of the ground-state rotational band. |
| 3248 *10* | (2$^+$) | | 0.011 *3* | |
| 3308 *9* | (2$^+$) | | | |

† From a least-squares fit to $\gamma$-ray energies.
‡ From 2011Sa25, based on previous assignments for low-lying levels, and shell-model predictions for levels above 1360 keV.
# Level population cross section (2011Sa25).

### $\gamma$($^{44}$S)

| E$_\gamma$† | E$_i$(level) | J$_i^\pi$ | E$_f$ | J$_f^\pi$ | Mult. | Comments |
|---|---|---|---|---|---|---|
| 949 *5* | 2268 | 2$^+$ | 1319 | 2$^+$ | | |
| 1040 | 3308 | (2$^+$) | 2268 | 2$^+$ | | E$_\gamma$: from 2017Pa02, not seen in 2011Sa25. |
| 1128 *6* | 2447 | 4$^+$ | 1319 | 2$^+$ | [E2] | B(E2)↓=0.00056 *18* (2017Pa02); B(E2)(W.u.)=0.61 *19* (2017Pa02) E$_\gamma$: other: 1140 (2017Pa02). B(E2)(W.u.) deduced by 2017Pa02 from their measured mean lifetime, and is interpreted as hindered E2 transition. |

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## $^{9}$Be($^{46}$Ar,$^{44}$S$\gamma$) 2011Sa25,2017Pa02,2006Fr13 (continued)

### $\gamma(^{44}S)$ (continued)

| $E_\gamma$ [†] | $E_i$(level) | $J_i^\pi$ | $E_f$ | $J_f^\pi$ |
|---|---|---|---|---|
| 1319 *7* | 1319 | $2^+$ | 0 | $0^+$ |
| 1891[‡#] *10* | 3248 | $(2^+)$ | 1357 | $0^+$ |
| 1929[‡#] *7* | 3248 | $(2^+)$ | 1319 | $2^+$ |
| 2150[#] *11* | 2150 | $(2^+)$ | 0 | $0^+$ |

† From 2011Sa25.
‡ Based on $\gamma\gamma$-coin data, placements of the 1891 and 1929 $\gamma$ rays from a 3248-keV level in 2011Sa25 could not be confirmed in 2017Pa02.
# Placement of transition in the level scheme is uncertain.

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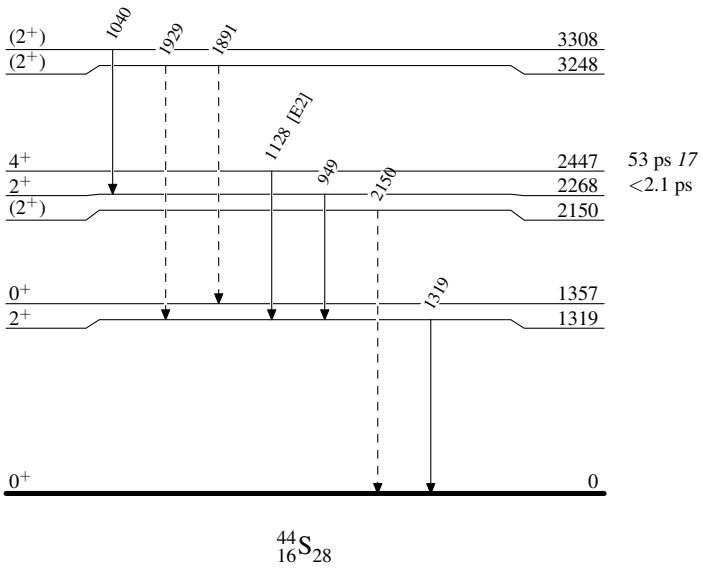
### Level Scheme




$^{44}_{16}S_{28}$